CRITICAL-POINT NUCLEI*

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Notable benchmarks of collective nuclear behavior are the harmonic vibrator, the axially symmetric deformed rotor, and the gamma-soft rotor. While nuclei may display behavior near these idealized limits, many lie in transitional regions between them. Recently, it has been suggested that a useful approach is to apply the ideas of a phase transition of the nuclear shape and to try to define critical points of the shape change as new benchmarks against which nuclear properties can be compared [1,2].

These descriptions involve analytic solutions of the Bohr collective Hamiltonian with potentials that approximate the "true" potential at the critical point of the shape change. The critical point of the shape transition from an axially deformed rotor to a spherical harmonic vibrator, denoted as X(5), involves a potential decoupled into two components – an infinite square well in the quadrupole deformation parameter, β, and a harmonic potential for the triaxiality deformation parameter, γ. The critical point of the transition from a γ-soft rotor to a spherical vibrator, denoted as E(5), involves a potential that is an infinite square well depending only on β.

Such descriptions have obvious limitations. These potentials are unrealistic (infinite square wells) and microscopic ingredients such as pairing correlations are ignored. However, several examples of critical-point nuclei have been suggested [3,4,5].

We have investigated a number of open questions concerning the applicability of critical-point descriptions of transitional nuclei (for our work published to date see [6,7]) including:

- Is there microscopic justification of the critical-point descriptions?
- How well do "traditional" approaches, such as band mixing, fare in comparison?
- What are the limitations of the critical-point descriptions - what can they explain, and where do they fail?
- What are the best examples of critical-point nuclei?
- Can we use similar descriptions for other types of transitional behavior (such as the change from pairing vibrations to pairing rotations in isospace)?

In this contribution we shall introduce the ideas of critical-point descriptions, survey the work that has appeared in the literature on the topic, and then focus on our recent efforts to address the above questions, including proposed new candidates for critical-point nuclei.

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